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(54) **A RAIL CLEANING METHOD AND A RAIL CLEANING DEVICE**

(57) The invention relates to a rail cleaning method comprising:
- applying a corrosion reduction liquid on a top surface of a rail (10) of a railway;
- letting the liquid work during an operation time period;
- applying a flush liquid on the rail to remove the corrosion reduction liquid and resolved substances; and
- collecting the residual liquid comprising used corrosion reduction liquid, used flush liquid and resolved substances.

The invention also relates to a rail cleaning device (1).

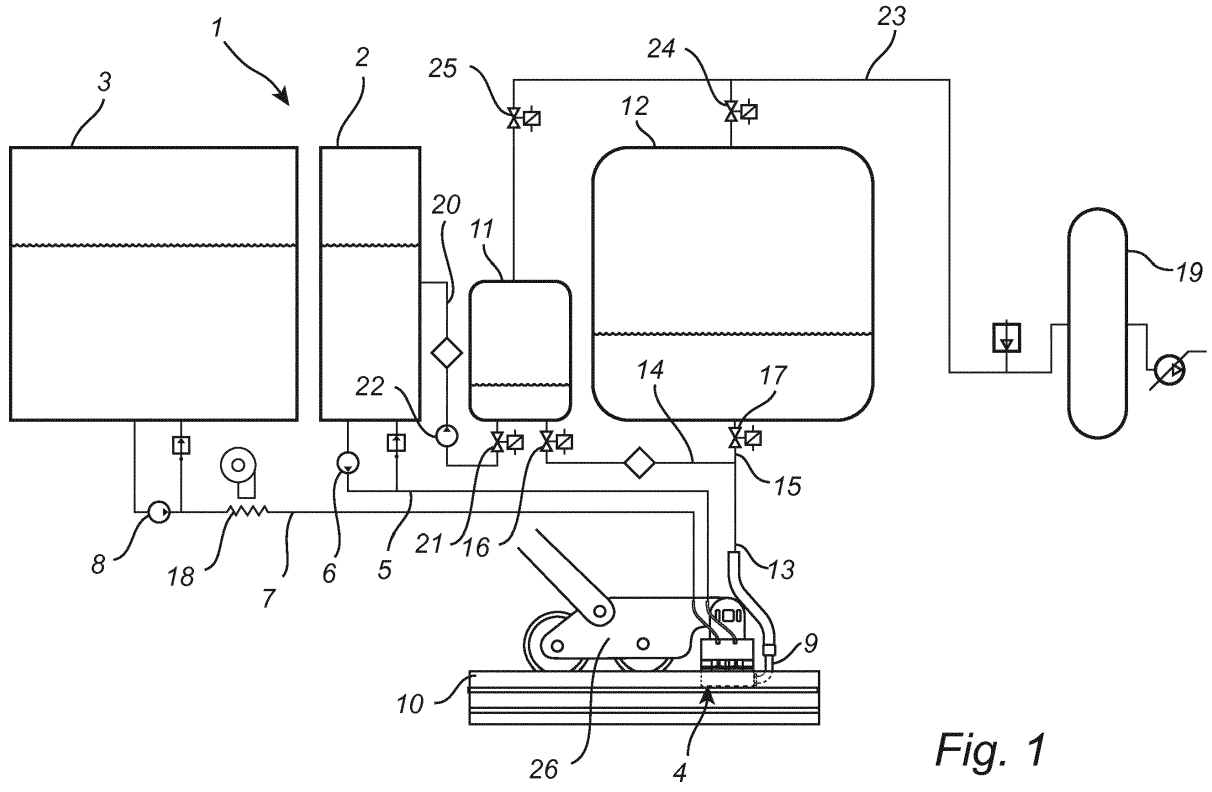

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the field of railway security, and more particularly to a rail cleaning method and device.

BACKGROUND OF THE INVENTION

[0002] A common problem with railroads is that the rails become slippery, i.e. the friction of the surface of the rails becomes reduced, causing a decreased drivability for railroad vehicles. In severe cases the problem causes railroad vehicles to stop in uphill slopes due to slipping wheels, or preventing railroad vehicles from braking due to slipping wheels, which may cause severe accidents. The problems are generally considered to be caused by deposits on the upper surfaces of the rails by, for example, leaves, bark, and ice.

[0003] Traditional methods for solving the problem include cleaning the rails from leaves, ice and other similar materials by means of brushes or high-pressure water jet cleaning, such as disclosed in GB2284186 and US6148732. During some parts of the year this kind of cleaning has to be made repetitively with short time intervals on large lengths of railroad. Additionally, often the increase of friction of the rail surfaces is not as good as expected and desired.

SUMMARY OF THE INVENTION

[0004] It would be advantageous to provide a solution to the above-mentioned problems.

[0005] To better address this concern, in a first aspect of the invention there is presented a rail cleaning method comprising applying a corrosion reduction liquid on a top surface of a rail of a railway, letting the liquid work during an operation time period, applying a flush liquid on the rail to remove the corrosion reduction liquid and resolved substances, and collecting the residual liquid comprising used corrosion reduction liquid, used flush liquid and resolved substances. According to this invention it has been discovered that a basic problem of low friction, in addition to those previously known within this field of technology, is surface corrosion of the rails, which is actually the major problem that causes the slippery conditions. Therefore, it is important to remove that corrosion in order to increase the friction to an acceptable level. Consequently, instead of just removing organic material when the problem of slipperiness has already occurred, and most temporary, and often just to a certain extent, reducing the problem, the current method is preventive. In other words, the treatment by the present method prevents the rail slipperiness from occurring for a substantial amount of time.

[0006] In accordance with an embodiment of the rail cleaning method said applying a corrosion reduction liquid comprises controlling the amount of corrosion reduction liquid to obtain a layer having a thickness t, where $t>0.05$ mm and $t<0.3$ mm, on the top surface.

[0007] In accordance with an embodiment of the rail cleaning method said applying a corrosion reducing liquid comprises controlling an application width of the corrosion reduction liquid to amount to at the most the width of the top surface.

[0008] In accordance with an embodiment of the rail cleaning method said controlling an application width comprises shielding the environment beside the upper surface.

[0009] In accordance with an embodiment of the rail cleaning method the corrosion reducing liquid contains an acid.

[0010] In accordance with an embodiment of the rail cleaning method the flush liquid comprises water. Thereby, if any liquid reaches the surrounding environment the environmental impact is neglectable.

[0011] In accordance with an embodiment of the rail cleaning method applying a corrosion reduction liquid comprises high-pressure spraying the corrosion reduction liquid on the top surface.

[0012] According to a second aspect of the invention, there is provided a rail cleaning device comprising a corrosion reduction liquid container, a flush liquid container, a liquid application device, arranged to apply liquid to a top surface of a rail of a railway, wherein the liquid application device comprises a residual liquid collector, arranged to collect residual liquid from the rail.

[0013] In accordance with an embodiment of the rail cleaning device the liquid application device comprises a spray nozzle for applying the corrosion reduction liquid, and a spray chamber through which the corrosion reduction liquid is sprayed.

[0014] In accordance with an embodiment of the rail cleaning device the spray chamber comprises side walls, spaced apart by a distance which is smaller than the width of the top surface of the rail, and extending longitudinally of the liquid application device, and end walls extending laterally of the liquid application device at a distance from each other, and being attached to the side walls.

[0015] In accordance with an embodiment of the rail cleaning device it comprises a pump for pressurising the corrosion reduction liquid to be applied under a high pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The invention will now be described in more detail and with reference to the appended drawings in which:

Fig. 1 is a schematic block diagram showing an embodiment of the rail cleaning device according to the present invention;

Figs. 2 and 4 are cut-away views of a liquid application device being a part of the rail cleaning device of

Fig. 1; and

Fig. 3 is a cross-sectional view of the part shown in Fig. 2.

DESCRIPTION OF EMBODIMENTS

[0017] An embodiment of the rail cleaning device 1 comprises a corrosion reduction liquid container 2, a flush liquid container 3, and a liquid application device 4. The liquid application device 4 is connected to the corrosion reduction liquid container 2 via a first conduit 5 and a first pump 6 connected with the first conduit 5, and to the flush liquid container 3 via a second conduit 7 and a second pump 8 connected with the second conduit 7. The liquid application device 4 is arranged to be positioned close to a rail 10 to be treated. A liquid heater 18 is connected to the second conduit 7 for heating the flush liquid flowing therein. The liquid application device 4 comprises a residual liquid collector 9, arranged to collect residual liquid from the rail 10. The rail cleaning device 1 further comprises a residual corrosion reduction liquid container 11, and a residual flush liquid container 12. The residual liquid collector 9 is connected to both of the containers 11, 12 via a third conduit 13, which extends from the residual liquid connector 9 and branches off into a first conduit branch 14 connected to the residual corrosion reduction liquid container 11, and into a second conduit branch 15 connected to the residual flush liquid container 12. The fluid through each conduit branch 14, 15 is controlled with first and second valves 16, 17 connected in each respective conduit branch 14, 15.

[0018] The residual corrosion reduction liquid container 11 is connected to the corrosion reduction liquid container 2 by means of a fourth conduit 20. A third valve 21, and a third pump 22 are connected to the fourth conduit 20 for controlling the transfer of corrosion reduction liquid from the residual corrosion reduction liquid container 11 to the corrosion reduction liquid container 2.

[0019] A vacuum device 19 is connected with the residual flush liquid container 12 and the residual corrosion reduction liquid container 11 via a vacuum pipe 23 and respective fourth and fifth valves 24, 25.

[0020] The rail cleaning device 1 is mounted on a suitable railway vehicle, of which only a bogie part 26 is shown in Fig. 1. The liquid application device 4 is attached to the bogie part 26.

[0021] The rail cleaning device 1 further comprises a first spray nozzle 27 attached to the end of the first conduit 5, a second spray nozzle 28 attached to the end of the second conduit 7, a first spray chamber 29 through which the corrosion reduction liquid is sprayed, and a second spray chamber 30, through which the flush liquid is sprayed. The first and second spray chambers 29, 30 end at the surface of the rail 10. More particularly, the liquid application device 4 is positioned at an upper portion of the rail called a rail head 31 having a top surface 32 and opposite side surfaces 33, 34, where the top surface 32 is curved at its longitudinal edges where it meets the side surfaces 33, 34. The side surfaces consist of an outer side surface 33 and an inner side surface 34. There is a small gap between liquid application device 4 and the top surface 32 in order to admit air into the spray chambers 29, 30 when spraying. Thereby, the residual liquid is sucked into the residual liquid collector 9 and prevented from being spread to the surroundings.

[0022] In order to minimize the environmental impact of the present device and method, the liquid application device 4 is arranged to apply the liquids primarily to a portion of the top surface 32 of the rail head 31 where the wheels of trains engage the rail head 31, and slightly beyond that, which portion is laterally limited to less than the total width of the rail head 31, and to avoid spreading the liquid to the surrounding environment by using the residual liquid collector 9. However, the liquid application device 4 can easily be modified to cover the whole width of the rail head 31 if desired, as understood by the person skilled in the art.

[0023] Therefore, the first chamber comprises side walls 35, 36, spaced apart by a distance which is smaller than the width of the rail head 31, and extending longitudinally of the liquid application device 4, and thus longitudinally of the rail 10, and end walls 37, 38, extending at a distance from each other and laterally of the liquid application device 4, and being attached to the side walls 35, 36. The side walls 35, 36 and the end walls 37, 38 end close to the top surface 32, and thereby limit the spray to hit the top surface within a top surface area defined by these walls 35-38. The second chamber is similarly defined by side walls and end walls.

[0024] Furthermore, the liquid application device 4 comprises residual liquid channels 39 extending along the liquid application device 4, along a side surface 33 of the rail head 31, preferably the outer side surface 33, and into the first and second chambers 29, 30. A lower portion 40 of the liquid application device 4 extends along and abuts against the outer side surface 33. Longitudinal portions of the residual liquid channels 39 are provided in that lower portion 40. The residual liquid channels 39 are comprised in the residual liquid collector 9, and are connected with the third conduit 13.

[0025] According to an embodiment of the present rail cleaning method, the rail cleaning device 1 is operated as follows. While the railway vehicle is driven along the railway, corrosion reduction liquid is pumped from the corrosion reduction liquid container 2 to the liquid application device 4, and is applied to the top surface 32. More particularly, as shown in Fig. 2, the corrosion reduction liquid is sprayed onto the top surface 32 by means of the first spray nozzle 27. The pressure used is adapted to the vehicle speed and to obtain a maximum adhesion of the corrosion reduction liquid to the top surface 32 without causing a separation of the constituents of the corrosion reduction liquid. The latter could occur if the pressure is too high. It has been shown by experiments and investigations that the problem of slippery rails is caused by the oxide layer caused by corrosion of the rail. The organic

material mentioned above is grained to dust by the wheels of the trains, and combines with the some of the oxide to form slippery compounds. Those compounds are relatively hard and the pressurised application of the corrosion reduction liquid enhances the solving effect of the liquid.

[0026] Excessive, i.e. residual, corrosion reduction liquid is collected by means of the residual liquid collector 9 and conducted to the residual corrosion reduction liquid container 11. More particularly, the vacuum device 19 generates a vacuum, which is delivered to the residual corrosion reduction liquid container 11 by opening the fifth valve 25 and further to the residual liquid collector 9 by opening the first valve 16. While applying the vacuum, air is let into the first chamber 29 through the gap between the liquid application device 4 and the rail 10, and thereby no liquid is allowed to pass out of the gap to the surrounding environment.

[0027] The applied corrosion reduction liquid is allowed to work for a time period to resolve the oxide layer of the rail 10. Then, as shown in Fig. 4, the flush liquid is pumped from the flush liquid container 3, to the liquid application device 4, and is applied to the top surface 32. More particularly, the flush liquid is sprayed onto the top surface 32 by means of the second spray nozzle 28 under high pressure generated by means of the second pump 8. Thereby the corrosion reduction liquid and substances, which have been resolved by the corrosion reduction liquid, are removed from the top surface 32 of the rail 10. Like the residual corrosion reduction liquid, the residual liquid, which is thus a blend of flush liquid, corrosion reduction liquid and resolved substances, is then collected by means of the residual liquid collector 9 and sucked to the residual flush liquid container 12. Similar to the removal of the residual corrosion reduction liquid, the vacuum device 19 generates a negative pressure, which is delivered to the residual flush liquid container 12 by opening the fourth valve 24 and further to the residual liquid collector 9 by opening the second valve 17.

[0028] The corrosion reduction liquid is applied in a layer having a thickness t, where $t>0.05$ mm and $t<0.3$ mm, on the top surface 32.

[0029] The corrosion reduction liquid is preferably environmentally friendly, by using an active ingredient that is an organic acid, which is easily degradable. Examples of useful groups of acid are oxalic acids and lactic acids. However, the person skilled in the art understands that there are other useful acids, which are good oxide solvents. The flush liquid preferably is merely water, which when heated and applied under a relatively high pressure is able to remove the solved substances from the rail 10. However, other liquids, or mixtures of water and other substances are feasible as well, as understood by the person skilled in the art.

[0030] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive. The invention is not limited to the disclosed embodiments.

[0031] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A rail cleaning method comprising:

   - applying a corrosion reduction liquid on a top surface (32) of a rail (10) of a railway;
   - letting the liquid work during an operation time period;
   - applying a flush liquid on the rail to remove the corrosion reduction liquid and resolved substances; and
   - collecting the residual liquid comprising used corrosion reduction liquid, used flush liquid and resolved substances.

2. The rail cleaning method according to claim 1, wherein said applying a corrosion reduction liquid comprises controlling the amount of corrosion reduction liquid to obtain a layer having a thickness t, where $t>0.05$ mm and $t<0.3$ mm, on the top surface.

3. The rail cleaning method according to claim 1 or 2, wherein said applying a corrosion reducing liquid comprises controlling an application width of the corrosion reduction liquid to amount to at the most the width of the top surface (32).

4. The rail cleaning method according to claim 3, wherein said controlling an application width comprises shielding an environment beside the upper surface.

5. The rail cleaning method according to any one of the preceding claims, wherein the corrosion reducing liquid contains an acid.

6. The rail cleaning method according to any one of the preceding claims, wherein the flush liquid comprises water.

7. The rail cleaning method according to any one of the preceding claims, said applying a corrosion reduction liquid comprises high-pressure spraying the cor-

rosion reduction liquid on the top surface (32).

8. The rail cleaning method according to any one of the preceding claims, comprising performing the method by means of a railway vehicle carrying a rail cleaning device (1).

9. A rail cleaning device comprising a corrosion reduction liquid container (2), a flush liquid container (3), a liquid application device (4), arranged to apply liquid to a top surface (32) of a rail (10) of a railway, wherein the liquid application device comprises a residual liquid collector (9), arranged to collect residual liquid from the rail.

10. The rail cleaning device according to claim 9, wherein the liquid application device (4) comprises a spray nozzle (27) for applying the corrosion reduction liquid, and a spray chamber (29) through which the corrosion reduction liquid is sprayed.

11. The rail cleaning device according to claim 10, wherein the spray chamber (29) comprises side walls (35, 36), spaced apart by a distance which is smaller than the width of the top surface of the rail, and extending longitudinally of the liquid application device (4), and end walls (37, 38) extending laterally of the liquid application device at a distance from each other, and being attached to the side walls.

12. The rail cleaning device according to any one of claims 9 to 11, comprising a pump (6) for pressurising the corrosion reduction liquid to be applied under a high pressure.

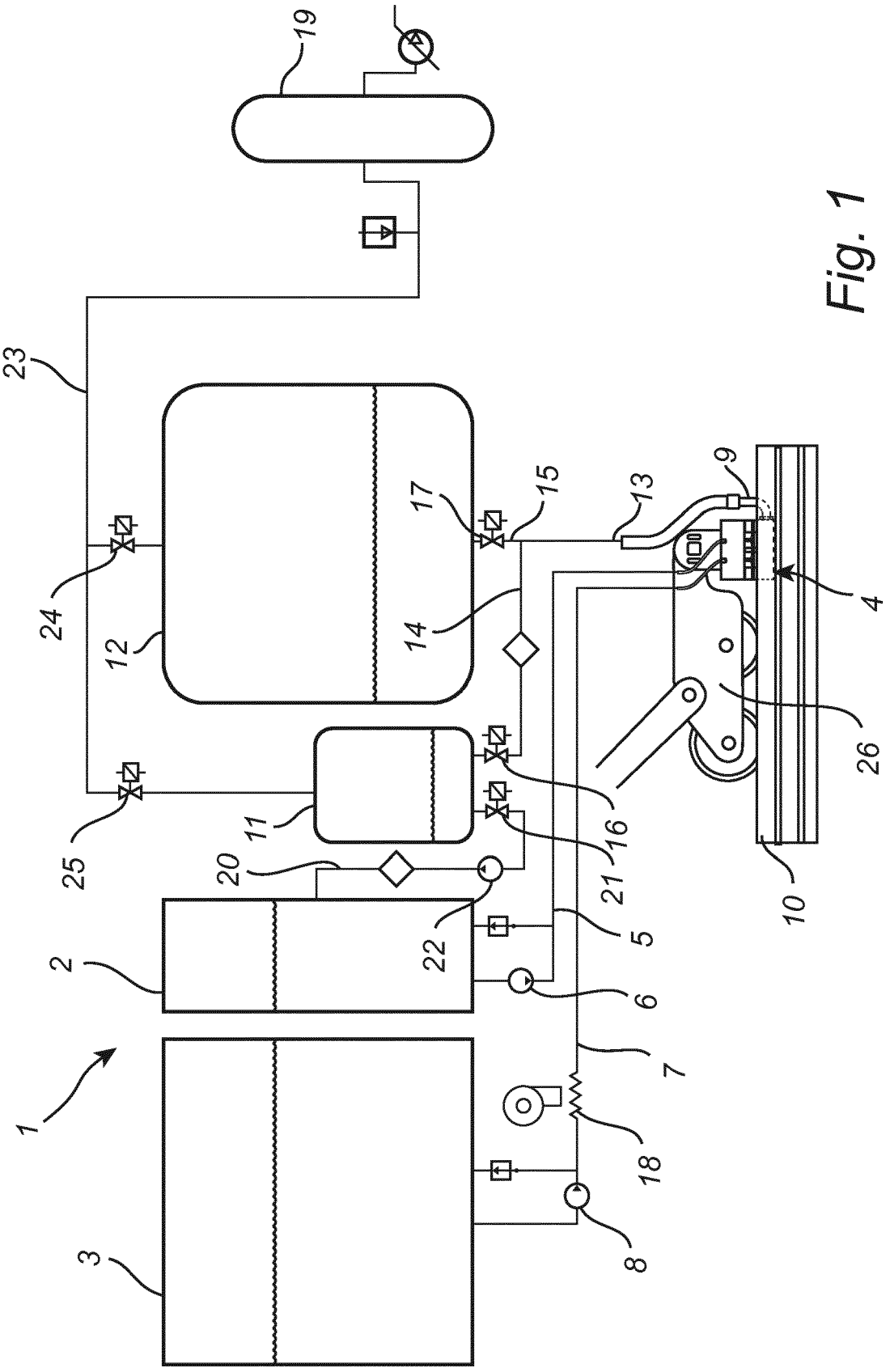

Fig. 1

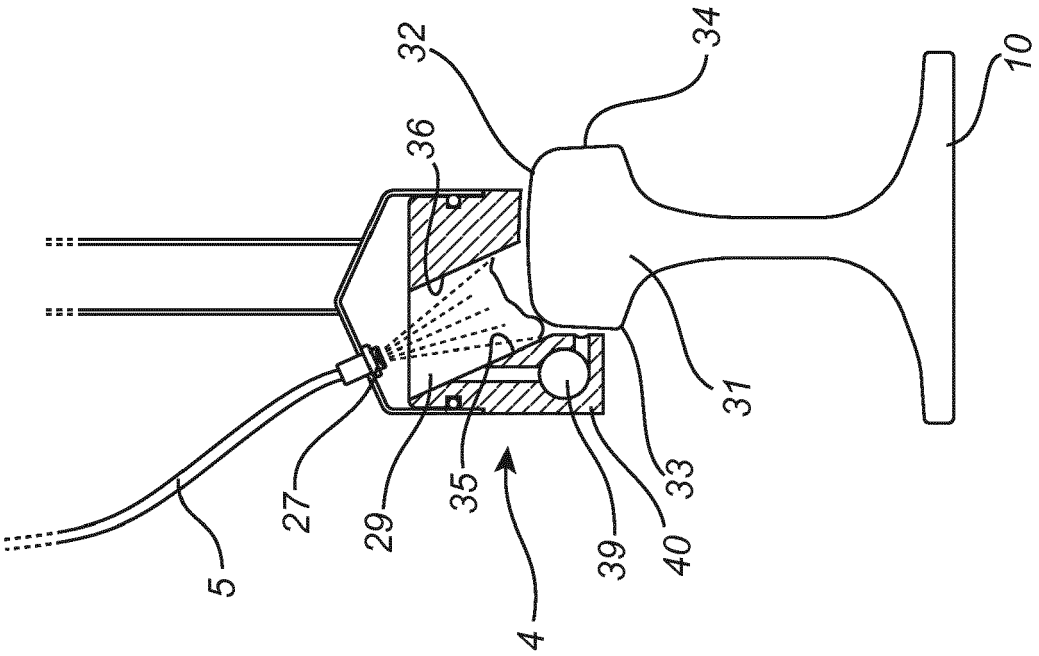

Fig. 3

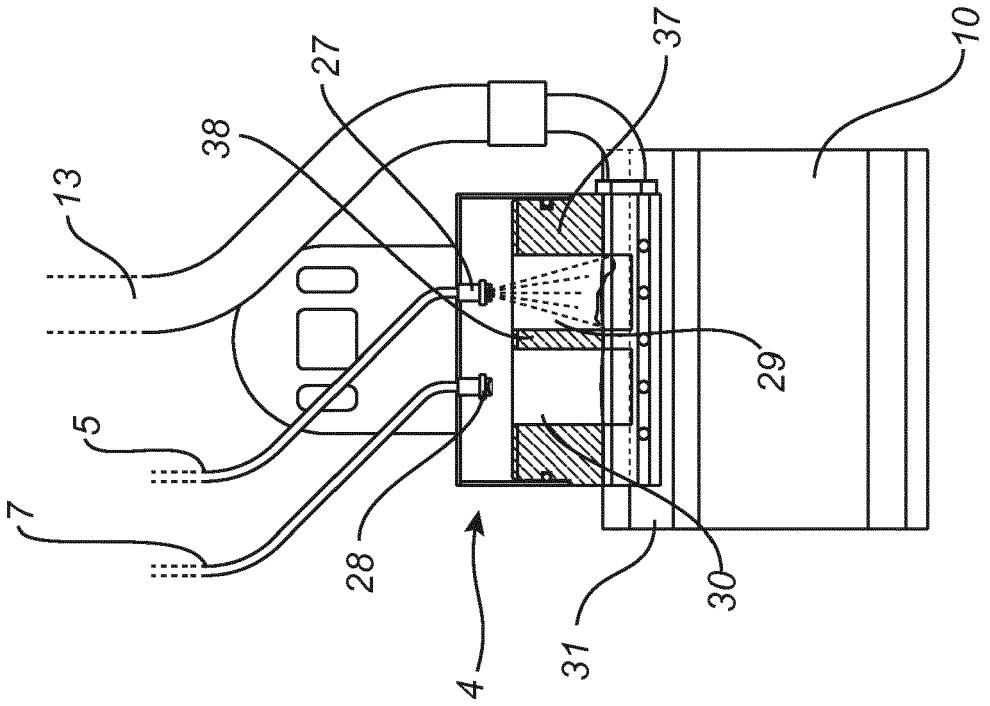

Fig. 2

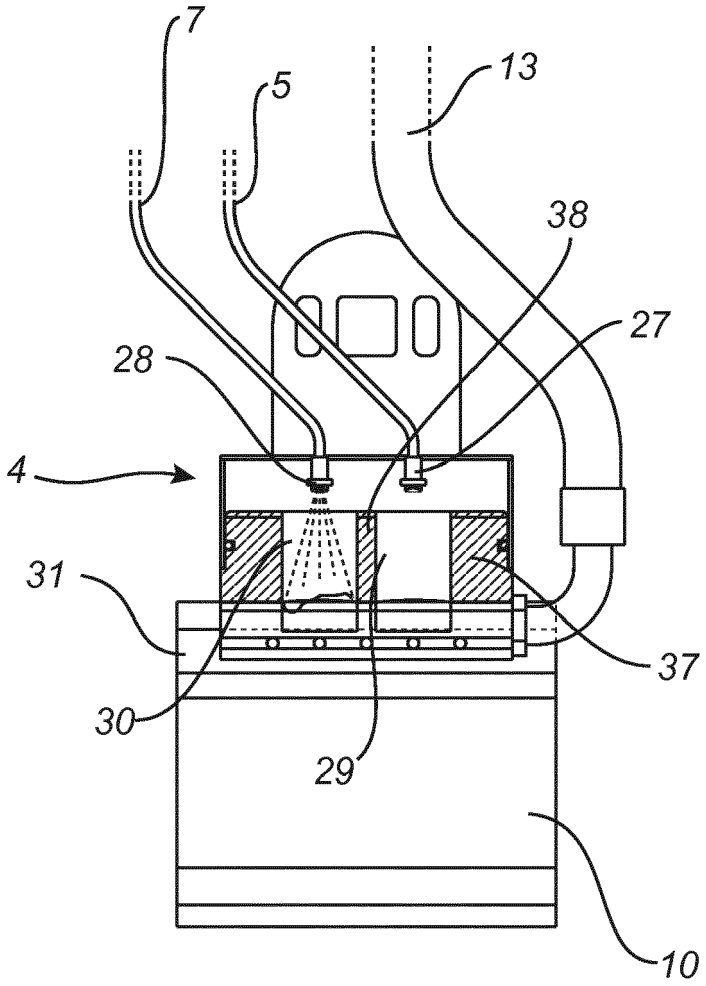

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 9475

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	CN 208 701 592 U (XINCHANG QUNJIAO AGRICULTURE DEV CO LTD) 5 April 2019 (2019-04-05) * the whole document *	1-12	INV. E01H8/10
Y	CN 208 649 980 U (CHONGQING JIANZHU COLLEGE) 26 March 2019 (2019-03-26) * the whole document *	1-12	
A	GB 2 563 082 A (ROLAND NORMAN PHILLIPS [GB]; RAYMOND VENABLES [GB]) 5 December 2018 (2018-12-05) * pages 14-16; figures 1,2 *	1-12	
A	CN 108 374 298 A (UNIV DONGGUAN TECHNOLOGY) 7 August 2018 (2018-08-07) * the whole document *	1,5,9	
			TECHNICAL FIELDS SEARCHED (IPC)
			E01H E01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 February 2020	Movadat, Robin

CATEGORY OF CITED DOCUMENTS

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14-02-2020

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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